INTERNATIONAL SEARCH REPORT

Information on patent family members

26/07/03

International application No.
PCT/SE 03/01090

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0223046 A1	21/03/02	CA 2421988 A	11/03/03
		DE 20015744 U	25/01/01
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 03/01090

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 2853264 A1 (WERNER RIETSCHLE MASCHINEN- UND APPARATEBAU, GMBH), 19 June 1980 (19.06.80), page 3, line 12 - line 25, claims 1-7 -- --------	6,11-13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 03/01090

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F04C 29/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F04C, F01C, A01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 0223046 A1 (WERNER RIETSCHLLE GMBH + CO. KG), 21 March 2002 (21.03.02), figure 1, claims, abstract	1,3,7,10,14, 15,17-19,22
Y	--	5,6,11-13,16
Y	US 5718565 A (M. KUHN ET AL), 17 February 1998 (17.02.98), column 2, line 5 - line 11, abstract	5-6
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Y	DE 29710303 U1 (SIHI GMBH & CO KG), 26 November 1998 (26.11.98), claim 1	16
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 Sept 2003	18 -09- 2003
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Jenny Petersson / MRo Telephone No. +46 8 782 25 00

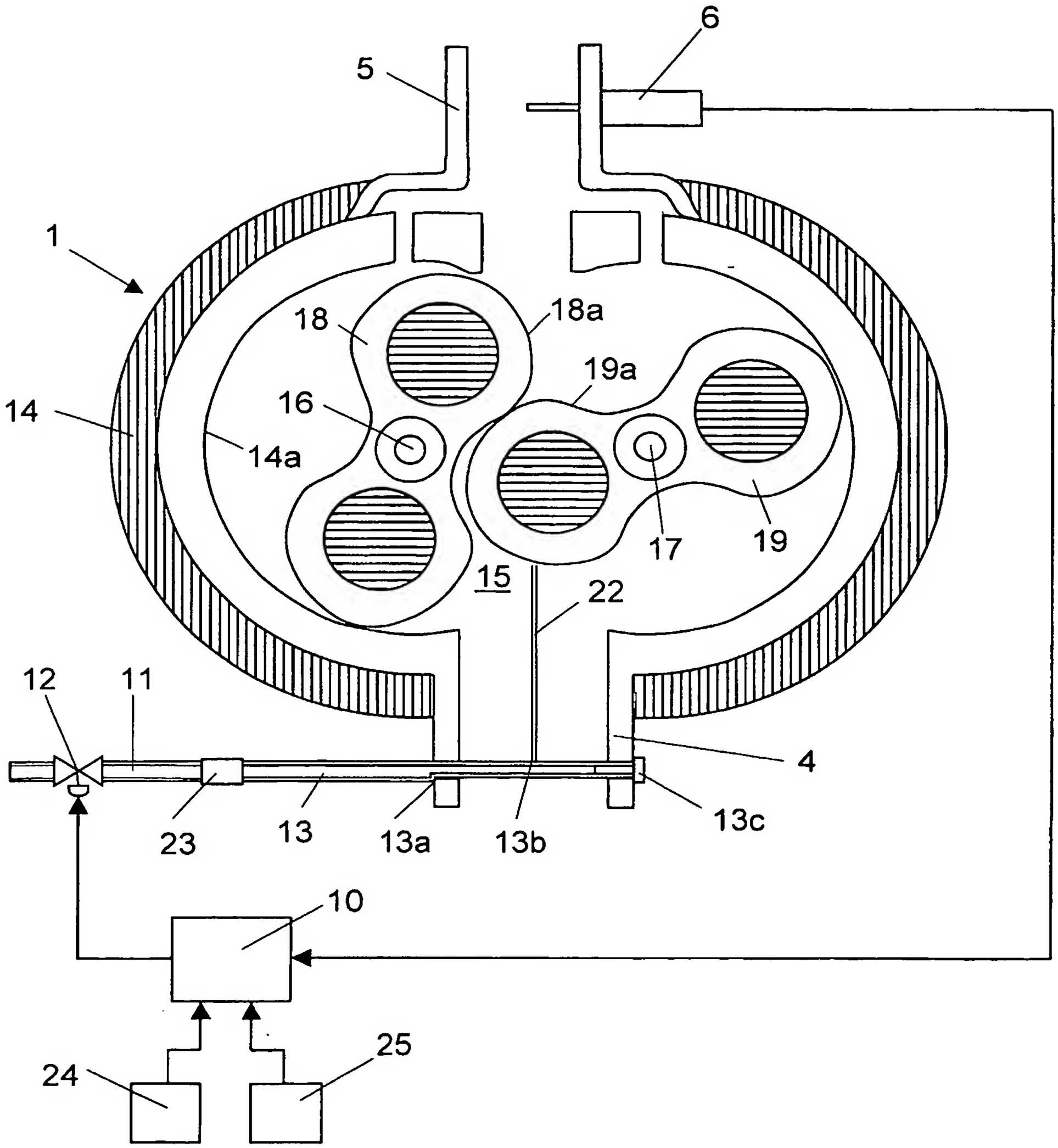
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Fig 2

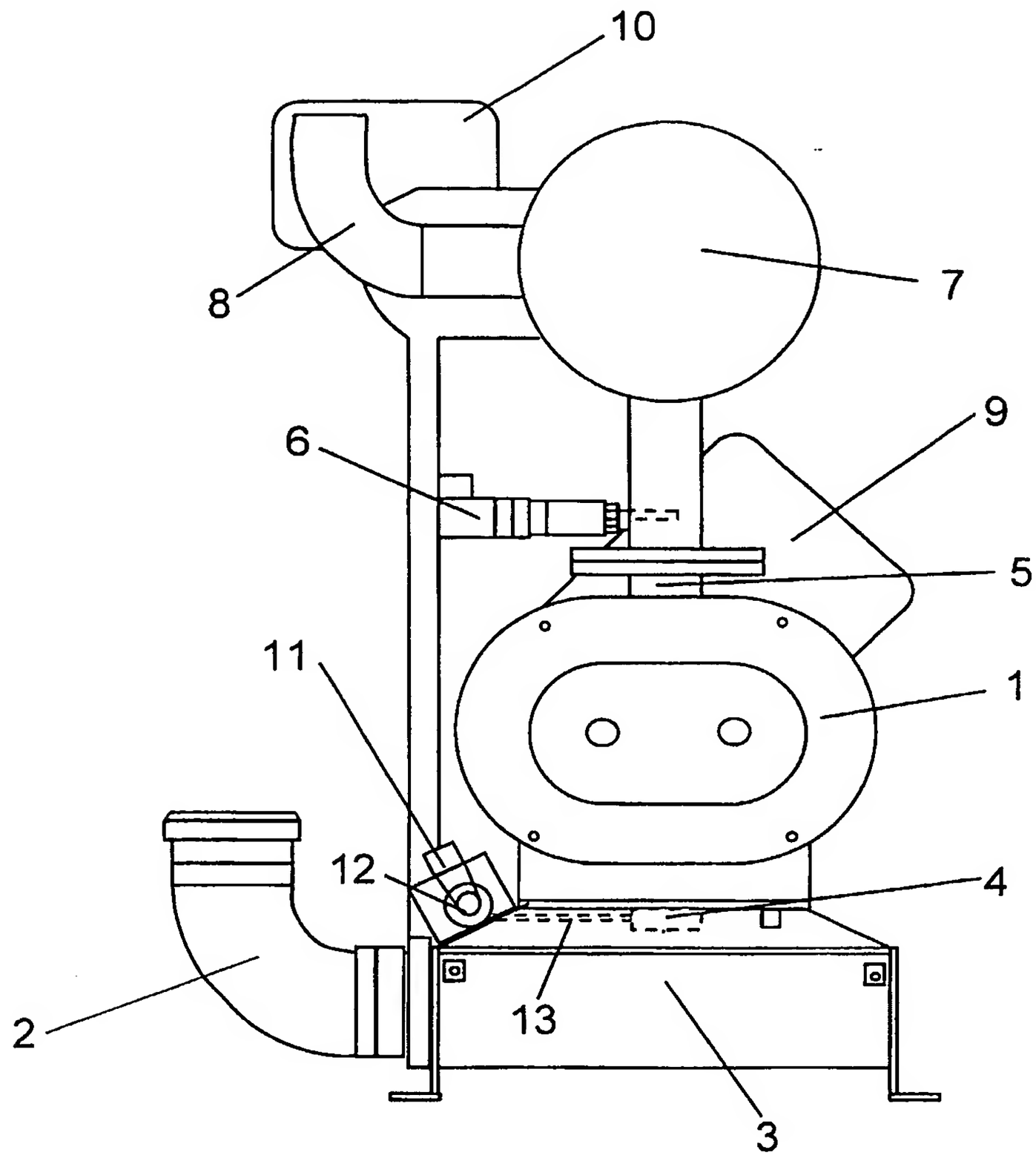

Fig 1

than during a normal operation of the vacuum pump (1) when said liquid is being supplied to said inner space (15).

21. A method according to any one of the claims 18 to 20, characterised by the step of: maintaining the operation of the vacuum pump (1) during a period of time after the liquid supply to the inner space has ended in order to remove the remaining liquid.

22. A method according to any one of the claims 18 to 21, characterised in that the vacuum system is operated intermittently and by the step of: initiating said liquid supply during the operation of the vacuum system.

17. A vacuum pump system comprising:

a vacuum pump comprising a housing (14) having a surface (14a) defining an inner space (15), at least one inlet opening (4) in the housing (14) arranged to lead a gaseous medium from a vacuum system to said inner space (15), at least one outlet opening (5) in the housing (14) arranged to lead the gaseous medium out from said inner space (15), and at least one rotor (18, 19) mounted in said space (15) and arranged to transport the gaseous medium from the inlet opening (4) to the outlet opening, and

an arrangement according to any one of the preceding claims connected to said vacuum pump.

18. A method for treatment of a vacuum pump (1) of the kind comprising a housing (14) having a surface (14a) defining an inner space (15), at least one inlet opening (4) in the housing (14) arranged to lead a gaseous medium from a vacuum system to said inner space (15), at least one outlet opening (5) in the housing (14) arranged to lead the gaseous medium out from said inner space (15), and at least one rotor (18, 19) mounted in said space (15) and arranged to transport the gaseous medium from the inlet opening (4) to the outlet opening (5), characterised by the step of: enabling a supply of liquid to said inner space (15) at certain occasions.

19. A method according to claim 16, characterised by the step of: monitoring at least one operation condition related to the operation of said vacuum pump (1) and

supplying said liquid to said inner space (15) at occasions when at least a certain condition of the vacuum pump (1) is detected by said monitoring.

20. A method according to claim 18 or 19, characterised by the step of: controlling the operation of said vacuum pump (1) such that the vacuum pump (1) is operated with an increased number of revolutions per time unit of said at least one rotor (18, 19)

(1) during a period of time after a liquid supply to the inner space has ended in order to remove the remaining liquid.

10. An arrangement according to claims 3 and 9, characterised in that the vacuum system is operated intermittently and the control unit (10) is arranged to initiate said liquid supply during operation of the vacuum system.

11. An arrangement according to any one of the preceding claims, characterised in that the liquid supplying device is arranged such that said liquid is supplied in the form of a liquid jet (22) into said inner space (15).

12. An arrangement according to claim 10, characterised in that the liquid supplying device is arranged such that the liquid jet (22) is injected in a direction towards said rotor (18, 19).

13. An arrangement according to claim 11 or 12, characterised in that the liquid supplying device is arranged such that the liquid jet (22) is injected through the inlet opening (4) to the inner space (15).

14. An arrangement according to any one of the preceding claims, characterised in that the vacuum pump is a lobe vacuum pump (1).

15. An arrangement according to any one of the preceding claims, characterised in that said liquid supplying device is arranged to supply a liquid in the form of water.

16. An arrangement according to any one of the preceding claims, characterised in that the vacuum pump (1) is used as the vacuum pump in a milking arrangement.

operation of said vacuum pump (1), wherein the control unit (10) is connected to said detection means (6, 24, 25) and arranged to control said liquid supply control member (12) to supply said liquid to said inner space (15) at occasions when at least a certain condition of the vacuum pump (1) is detected by said detection means (6, 24, 25).

6. An arrangement according to claim 5, characterised in that said detection means (6, 24, 25) is arranged to, directly or indirectly, detect whether a certain amount of deposits have been formed on the surface (18a, 19a) of said rotor and/or on the inner surface (14a) of said vacuum pump (1) and wherein the control unit (10) is arranged to control said liquid supply control member (12) to supply said liquid to said inner space (15) when such deposits are detected.

7. An arrangement according to claim 5 or 6, characterised in that said detection means (6, 24, 25) are arranged to, directly or indirectly, detect an operating temperature of the vacuum pump (1) and wherein the control unit (10) is arranged to control said liquid supply control member (12) to supply said liquid to said inner space (15) when the detected operating temperature exceeds a certain level.

8. An arrangement according to any one of claims 4 to 7, characterised in that the control unit (10) is also arranged to control the operation of said vacuum pump (1) such that the vacuum pump (1) is operated with an increased number of revolutions per time unit of said at least one rotor (18, 19) than during a normal operation of the vacuum pump (1) when said liquid is being supplied to said inner space (15).

9. An arrangement according to any one of the preceding claims, characterised in that the arrangement comprises control means arranged to maintain the operation of the vacuum pump

Claims

1. An arrangement for the treatment of a vacuum pump (1) of the kind comprising a housing (14) having a surface (14a) defining an inner space (15), at least one inlet opening (4) in the housing (14) arranged to lead a gaseous medium from a vacuum system to said inner space (15), at least one outlet opening (5) in the housing (14) arranged to lead the gaseous medium out from said inner space (15), and at least one rotor (18, 19) mounted in said space (15) and arranged to transport the gaseous medium from the inlet opening (4) to the outlet opening (5), wherein the arrangement comprises a liquid supplying device (11, 13) which is arranged to enable a supply of liquid to said inner space (15), characterised in that the arrangement comprises a liquid supply control member (12) which is arranged to enable the control of the supply of liquid of said liquid supply device to said inner space (15) such that the liquid is supplied to said inner space (15) only at certain occasions.

2. An arrangement according to claim 1, characterised in that said liquid supply control member (12) is arranged to be manually operated.

3. An arrangement according to claim 1, characterised in that the arrangement comprises a control unit (10) arranged to automatically control said liquid supply control member (12).

4. An arrangement according to claim 3, characterised in that said control unit (10) is arranged to automatically control said liquid supply control member (12) such that the liquid is supplied to said inner space intermittently at preselected intervals when the vacuum pump is in operation.

5. An arrangement according to claim 3, characterised in that the arrangement comprises detection means (6, 24, 25) arranged to detect at least one operation condition related to the

operating time. If water has been supplied to the inner space of the vacuum pump 1 in order to cool the vacuum pump, the supplied water naturally also cleans the vacuum pump and vice versa.

The invention is not restricted to the described embodiment disclosed in the figures, but may be varied freely within the scope of the claims. Preferably, the arrangement being used with a lobe vacuum pump but may also be used with other kinds of vacuum pumps, which comprises a rotor arranged in a housing. The supply of water may alternatively be performed automatically intermittently at preselected intervals during the operation of the vacuum pump. The supply of water may also be manually operated. The number of revolutions of the vacuum pump may be the initiated number of revolutions for the operation of the vacuum pump.

revolutions. The number of revolutions is increased to a suitable predetermined value. The increased number of revolutions of the vacuum pump 1 lowers the pressure in the vacuum system below the desired vacuum level. The vacuum regulator in the vacuum system opens and air is supplied to the vacuum system in order to maintain the desired vacuum level. Hereby, air is transported through the vacuum pump 1. The control unit 10 adjusts the water valve 12 to an open position and water is guided from the water conduit 11 to the injection pipe 13 and the nozzle 13b. From the nozzle 13b, a water jet 22 is obtained straight upwards towards the rotors 18, 19 in the centre of the inner space 15 of the housing 14. Thereby, the surfaces 18a, 19a of the rotors are directly cooled by the water jet 22. Due to the rotation of the rotors 18, 19, the main part of the surface 18a, 19a of the rotors are cooled directly by the water jet 22. The water jet 22 may be injected for a predetermined period of time or until the outlet temperature has reached an acceptable operating temperature. Such a temperature may be about 60-70°C. The rotors 18, 19 are here primary cooled and the housing 14 obtains a secondary cooling. By such a cooling process, the small play between the surfaces 18a, 19a of the rotors and the surfaces 15a of the inner space increases during the cooling process and the risk for jamming there between is eliminated. When the water-injecting period has ended, the vacuum pump 1 is continuously driven at the predetermined number of revolutions a further period of, for example, 10 seconds. Thereby, the air blows out the remaining water from the vacuum pump 1 and the sound absorber 7. The vacuum pump 1 is then suitably operated as normally for a period of about 20 minutes. Thereby, the vacuum pump 1 and the sound absorber 7 are completely dry when the vacuum pump 1 is stopped.

The cleaning process and the cooling process are here performed automatically at need during the operation of the vacuum pump 1. Thereby, the vacuum pump 1 obtains a long

in order to maintain the desired vacuum level. Hereby, an air transportation through the vacuum pump 1 is guaranteed. The control unit 10 adjusts the water valve 12 to an open position and water flows from the water conduit 11, via the injection pipe 13 to the nozzle 13b. A water jet 22 is obtained from the nozzle 13b straight upwards towards the surfaces 18a, 19a of the rotors in the centre of the inner space 15. The water jet 22 may be supplied to the inner space 15 during a predetermined period of about 10 seconds. Due to the rotation of the rotors 18, 19, the main part of the surfaces 18a, 19a of the rotors are hit by the water jet 22. During the transportation of the supplied water through the vacuum pump 1, the water removes the deposits on the surfaces 18a, 19a of the rotors and the inner surfaces 14a of the housing. The control unit 10 checks, during the cleaning process, that the air temperature in the outlet pipe 5 decreases in order to verify that water really has been injected. When the predetermined injecting period has ended, the vacuum pump 1 is still driven at the predetermined number of revolutions of, for example, for a further period of about 10 seconds. Thereby, the air flowing through the vacuum pump 1 blows out the main part of the remaining water from the vacuum pump 1 and the sound absorber 7. Thereafter, the vacuum pump 1 operates normally for a period of about 20 minutes. Thereby, the vacuum pump 1 and the sound absorber 7 are completely dry when the vacuum pump 1 is stopped and the risk for corrosion of the vacuum pump 1 and the sound absorber 7 is eliminated.

The control unit 10 is also arranged to check that the outlet temperature does not exceed a certain temperature level. If, for example, a maximum operating temperature of the vacuum pump is 160°C then a threshold temperature level may be chosen at 150°C giving a safety margin of 10°C. When the control unit 10 receives information from the temperature sensor 6 that the outlet temperature has exceeded 150°C, the control unit 10 sends a signal to the electric motor 7 to increase the speed of the vacuum pump 1 to a predetermined number of

outlet temperature of the air decreases. Since, a more effective transportation of the air through the vacuum pump is achieved with smaller plays, the electricity consumption decreases. The more effective transportation of the air through the vacuum pump may be performed with a lower number a revolutions of the vacuum pump.

The control unit 10 checks if the condition for a successful cleaning process is fulfilled. The control unit 10 checks, for example, if the outlet temperature of the air exceeds a predetermined limit temperature, of about 110°C, in order to guarantee a following successful drying of the vacuum pump. The control unit 10 may comprise a control means arranged to maintain the operation of the vacuum pump 1 during a predetermined period of time e.g. 15 minutes after the liquid supply to the inner space has ended. Thereby, it is guaranteed that the pump 1 and the sound absorber 7 are completely dry when the vacuum pump 1 is stopped and the risk for corrosion is eliminated. Preferably, the control unit 10 initiates said liquid supply when a cleaning process of the milking arrangement is started. Such a cleaning process is performed during a period of about 20 minutes and guarantees a transportation of air through the vacuum pump 1 during this period. The control means may comprise an indicator lamp, which may be lit during said 20 minutes period and indicate to an operator that the vacuum pump 1 not should be stopped.

If the control unit 10 has estimated that a successful cleaning process may be performed, a signal is sent to the electric motor 9 to increase the number of revolutions of the vacuum pump 1. The number of revolutions is increased to a predetermined value, which is suitable for the cleaning process and the following drying process. The increased number of revolutions of the vacuum pump 1 lowers the pressure in the vacuum system below the desired vacuum level. A vacuum regulator in the vacuum system opens and air is supplied to the vacuum system

position by the control unit 10 in order to control the injection of water to the vacuum pump 1. The temperature sensor 6 is arranged to measure the temperature of the air in the outlet pipe 5 and transmit a signal related to the value of the temperature to the control unit 10. A revolution indicator 24 is arrange to measure the number of revolutions of the vacuum pump 1 and an electricity meter 25 is arranged to measure the electricity consumption of the electric motor 9. Both the revolution indicator 24 and the electricity meter 25 transmit a signal to the control unit 10 related to measured values.

During operation, the lobe vacuum pump 1 is arranged to maintain a substantially constant vacuum level in the vacuum system of the milking arrangement. At the start of the milking arrangement and during the attachment of milking members to animals to be milked, a relatively high capacity is required by the vacuum pump 1 in order to maintain the vacuum level in the vacuum system. During the remaining periods, a relatively low capacity of the vacuum pump 1 is required. The control unit 10 receives substantially continuous information from the temperature sensor 6, the revolution indicator 24 and the electricity meter 25 about measured values. Such measured values indicate the condition of the vacuum pump. The control unit 10 compares the received measurements with stored reference values for the specific vacuum pump 1. If the measured values concerning the number of revolutions of the lobe vacuum pump 1, the outlet temperature and the electricity consumption has decreased below the reference values with a predetermined percentage value, the control unit 10 notes that deposits have been formed on the surfaces 18a, 19a of the rotors and/or on the inner surface 14a of the housing. Namely, when deposits form on the surfaces of the rotors 18, 19, the deposits decreases the play between the rotors 18, 19 and the inner surface 14a of the housing. A smaller quantity of the heated air at the high-pressure side of the inner space is leaked back to the cold air at the low-pressure side. Therefore, the

lobe vacuum pump 1 is cooled by the air transported through the vacuum pump 1.

Usually, milking arrangements require a low capacity of the vacuum pump during long periods. During such periods, the vacuum pump many times has to be operated with a too high number of revolutions in order to prevent a too high operating temperature. Another problem with conventional lobe vacuum pumps in milking arrangements, is that deposits may form on the surfaces of the rotors and on the inner surfaces of the housing. The deposits originate principally from the milk in the milk arrangement. In order to remove the deposits, it may be necessary to dismount the vacuum pump and perform a manual cleaning of its inner surfaces at regular intervals.

In order to eliminate these disadvantages, the lobe vacuum pump according to the present invention, comprises the above mentioned liquid supplying device, which is arranged to allow a supply of liquid to the inner space 15 of the housing 14 at certain occasions when an unacceptable condition of the vacuum pump 1 has arisen. Thus, the liquid supplying device comprises the injector pipe 13. The injector pipe 13 is mounted in holes, which extend through walls of the inlet pipe 4. The injector pipe 13 has a stop lug 13a, which together with the shape of the holes guarantee that the injector pipe 13 obtains a correct mounting position in the inlet pipe 4. At such a position, a nozzle 13b of the injector pipe 13 has a central position in the inlet pipe 4. The nozzle 13b is directed upwardly and is arranged to provide an injection of a liquid jet 22 to a central position of the inner space 15 and towards the rotors 18, 19. The injector pipe 13 is locked in the mounting position by a bolt 13c inserted through one of the holes, which extends through the walls of the inlet pipe 4. The head of the bolt 13c locks the injector pipe 13 in the mounting position. The injector pipe 13 is connected to the water conduit 11 via a coupling member 23. The valve 12 is adjustable between a closed and an open

via the inlet conduit 2, the filter 3 and an inlet pipe 4, to the lobe vacuum pump 1. The air is compressed in the lobe vacuum pump 1 and transported out through an outlet pipe 5. A temperature sensor 6 is located in the outlet pipe 5 and is arranged to measure the outlet temperature of the compressed air. The air is transported through a sound absorber 7, which reduces the noise generated from the air flowing through the vacuum pump, before the air is guided out via an outlet conduit 8. The lobe vacuum pump 1 is driven by an electric motor 9. The arrangement for treatment of the lobe vacuum pump 1 comprises a liquid supplying device and a liquid supply control member. The liquid supplying device comprises a water conduit 11 and an injector pipe 13 in order to enable a supply of water to the vacuum pump 1. The liquid supply control member comprises a valve 12, which is arranged to enable control over the water supply to the vacuum pump 1. A control unit 10 is arranged to automatically control the valve 12. The control unit 10 may be a computer unit with suitable software. Alternatively, the control unit may be a PLC (programmable logic controller) or a relay initiating the liquid supply dependent on received signal e.g. from the temperature sensor 6.

Fig. 2 shows a cross view through the lobe vacuum pump 1. The lobe vacuum pump 1 comprises a housing 14 having an inner surface 14a defining an inner space 15. Two shafts 16, 17 are rotatably supported and are parallel within the inner space 15. A lobe type rotor 18, 19 is provided on each of the rotating shafts 16, 17. The lobe type rotors 18, 19 are driven synchronously in opposite directions. Thereby, the surfaces 18a, 19a of the rotors co-operate with each other and the inner surface 14a of the housing such that air is compressed and transported through the vacuum pump 1 from the inlet pipe 4 to the outlet pipe 5. The inner surfaces 14a and the surfaces 18a,19a of the rotors 18, 19 operate with a small play between each other. Since the surfaces 14a, 18a, 19a are not in contact with each other, the lobe vacuum pump 1 does not need any oil for lubrication. The

invention comprises also a vacuum pump system comprising: a vacuum pump and an arrangement according to any of the claims 1-16.

Finally, the invention comprises a method for treatment of a vacuum pump. The method comprises the step of: enabling a supply of liquid to said inner space at certain occasions. Thereby, a cooling and cleaning of the vacuum pump is obtained during the operation of the vacuum pump. Preferably the method comprises the step of: detecting at least one operation condition related to the operation of said vacuum pump and supplying said liquid to said inner space at occasions when at least a certain condition of the vacuum pump is detected. Hereby, liquid is automatically supplied to the inner surface of the vacuum pump when a cooling or a cleaning of the vacuum pump is needed.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is now to be explained more closely by means of a preferred embodiment, which is disclosed as an example, and with reference to the attached drawings.

Fig. 1 shows a view of an arrangement for treatment of a lobe vacuum pump,

Fig. 2 shows a cross view through the lobe vacuum pump in Fig.1.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Fig. 1 shows a vacuum pump system comprising a lobe vacuum pump 1. The lobe vacuum pump 1 is connected to a vacuum system in a milking arrangement via an inlet conduit 2 and a filter 3. The filter 3 is arranged to filter out particles from the vacuum system larger than, for example, 10 microns. A gaseous medium, in the form of air is sucked from the vacuum system,

surface of the housing during the transportation through the vacuum pump. The liquid supplying device may be arranged such that the liquid jet is injected through the inlet opening to the inner space. The liquid is here substantially forced by the pressure of the water jet to the inner space of the housing. Furthermore, a separate inlet opening for the liquid does not need to be arranged in the housing. Preferably, the liquid supplying device is arranged to inject the liquid towards a central position of the inner space. Hereby, the liquid is guaranteed to hit the rotors such that an effective cooling and cleaning of the surfaces of the rotors is obtained. Alternatively, the liquid may be sucked into the inner space of the housing by the gaseous medium.

According to a further embodiment of the invention, the vacuum pump is a lobe vacuum pump. Lobe vacuum pumps have a high capacity and a long operating time. Lobe vacuum pumps are harmless to the environment since they do not need any lubricants. The lobe vacuum pumps are cooled by the air transported through the pump. By supplying liquid at certain occasions to the lobe vacuum pump, an additional cooling of the pump is achieved. Thereby, the vacuum pump may be operated at a low number of revolutions without being overheated. Advantageously, the liquid supplying device is arranged to supply a liquid in the form of water. Water is both suitable to be used for cooling and for cleaning. The vacuum pump may be designed to be used as the vacuum pump in a milking arrangement. A problem with conventional lobe vacuum pumps in milking arrangements is that deposits may be formed on the surfaces of the rotors and the inner surfaces of the housing. Such deposits originate from the milk but also from e.g. detergents, dust and hay. By the supply of pure water or water with a suitable detergent to the lobe vacuum pump, the inner surfaces of the lobe vacuum pump are cleaned from the milk deposits at the same time as the vacuum pump is cold. Suitable detergents may be alkali detergents or acid detergents.The

liquid is supplied to said inner space, such that liquid is guaranteed to be transported through and out from the vacuum pump. Preferably, the arrangement comprises a control means arranged to maintain the operation of the vacuum pump during a period after the liquid supply to the inner space has ended in order to remove the remaining liquid. Consequently, the rotor continues to operate a period after the liquid supply to the inner space has ended. Hereby, an airflow is obtained through the pump, which guaranties a complete drying of the inner surfaces of the vacuum pump. Thereby, the risk for corrosion of the inner surfaces of the vacuum pump due to the supplied liquid is negligible. Certain, vacuum systems are operated intermittently. Hereby, the control unit may be arranged to initiate said liquid supply during the operation of the vacuum system. In a milking arrangement, an operation may be a cleaning process of the milking equipment or a suitable work operation performed by a milking robot. If the control unit, initiates said liquid supply when an operation of the milking arrangement is started, a determined minimum air quantity is guaranteed to be transported through the vacuum pump during a determined period of time thus, completely drying the inner surfaces of the vacuum pump.

According to a further embodiment of the invention, the liquid supplying device is arranged such that said liquid is supplied in form of a liquid jet into said inner space. Such a liquid jet may be injected with a suitable pressure and towards a selected surface of the inner space. Preferably, the liquid supplying device is arranged such that the liquid jet is injected in a direction towards said rotor. Hereby, the rotor obtains a primary cooling and the housing a secondary cooling. Such a cooling is favourable since it results in a larger play between the rotors and the inner surface of the housing. Hereby, the risk for jamming and breaking down of the vacuum pump, during the supply of the liquid to the inner space, is substantially eliminated. At the same time, the supplied liquid removes possible deposits from the surfaces of the rotors and the inner

deposits may be detected in a plurality of ways. When deposits are formed on the surfaces, the number of revolutions of the vacuum pump decrease, the power consumption of the vacuum pump decreases, the operating temperature of the vacuum pump decreases and the vibration level from the vacuum pump increase. The detection means may comprise one or more sensors which measure one or several of the above mentioned parameters. The control unit may compare the measured values with stored reference values for the specific vacuum pump. If such a comparison indicates that deposits of an unacceptable thickness have been formed on the inner surfaces of the vacuum pump, the liquid supply control member is activated.

According to a preferred embodiment of the invention said detection means are arranged to, directly or indirectly, detect an operating temperature of the vacuum pump and wherein the control unit is arranged to control said liquid supply control member to supply said liquid to said inner space when the detected operating temperature exceeds a certain level. By using detection means comprising a sensor, which measures, for example, the temperature of the output gaseous medium from the vacuum pump, an indirect detection of the operating temperature of the vacuum pump is achieved. Hereby, a maximum temperature level of the output gaseous medium may be defined at which the liquid supply control member is activated. Thereby, the arrangement provides an automatic control, which prevents the operating temperature of the vacuum pump to exceed a predetermined operating temperature level.

According to a further embodiment of the invention, the control unit is also arranged to control the operation of said vacuum pump such that the vacuum pump is operated with an increased number of revolutions per time unit of said at least one rotor when said liquid is supplied to said inner space than during a normal operation of the vacuum pump. The number of revolutions of said rotor has to be relatively high, when said

member, which may be a suitable valve member. Alternatively, an operator may manually operate, for example, a spring returned button connected to the valve member such that liquid may be supplied to the inner surface of the vacuum pump as long as the button is depressed.

According to a preferred embodiment of the invention, the arrangement comprises a control unit arranged to automatically control said liquid supply control member. In this case, an operator does not need to remember and initiate the liquid supply for the treatment of the vacuum pump. Said control unit may be arranged to automatically control said liquid supply control member such that the liquid is supplied to said inner space intermittently at preselected intervals when the vacuum pump is in operation. At suitable short selected intervals, deposits are prevented to be formed on the inner surfaces of the vacuum pump and the vacuum pump is cooled with regular intervals. Alternatively, the arrangement comprises detection means arranged to detect at least one operation condition related to the operation of said vacuum pump, wherein the control unit is connected to said detection means and arranged to control said liquid supply control member to supply said liquid to said inner space at occasions when at least a certain condition of the vacuum pump is detected by said detection means. In this case, liquid is automatically supplied to the inner space of the vacuum pump, when the detection means detects that the vacuum pump has a condition when it has to be cooled or has to be cleaned.

According to a preferred embodiment of the invention, said detection means are arranged to, directly or indirectly, detect whether a certain amount of deposits have been formed on the surface of said rotor and/or on the inner surface of said vacuum pump and wherein the control unit is arranged to control said liquid supply control member to supply said liquid to said inner space when such deposits are detected. The formation of

a vacuum system, and an outlet port. Two rotors are arranged in the inner space for pumping air from the suction port to the outlet port. A suction opening for a cooling liquid is located near the suction port for the air. The cooling liquid is sucked into the inner space in order to enter a play between the rotors and a play between the rotors and the inner peripheral surface of the body case.

SUMMARY OF THE INVENTION

The object of the present invention is to provide an arrangement and a method for treatment of a vacuum pump in order to reduce the maintenance requirement of the vacuum pump and to provide a longer operating time of the vacuum pump.

This object is achieved in that the arrangement comprises a liquid supply control member which is arranged to enable the control of the supply of liquid of said liquid supply device to said inner space such that the liquid is supplied to said inner space only at certain occasions. Such a liquid supply provides an additional cooling of the vacuum pump. Such a liquid supply also removes possible deposits from the inner surfaces of the vacuum pump. By such a cleaning and an additional cooling of the vacuum pump performed during the operation of the vacuum pump, the maintenance requirement of the vacuum pump is reduced and a longer operating time of the vacuum pump is obtained. Furthermore, an operation of the vacuum pump at a lower number of revolutions is possible and the vacuum pump may maintain a lower vacuum in the vacuum system without overheating.

According to an embodiment of the invention, the liquid supply control member is arranged to be manually operated. A determined liquid amount may here be supplied to the inner space of the vacuum pump during a predetermined time after that an operator manually has activated the liquid supply control

in milking arrangements are, in practice, usually used with a low number of revolutions, which many times is lower than a recommended lowest number of revolutions.

Several types of vacuum pumps can be used e.g. vane pumps and lobe pumps. Lobe vacuum pumps are suitably used when a high capacity and a long operating time are required. Lobe vacuum pumps operate with a play between the rotors and between the rotors and the housing. Therefore, the lobe vacuum pumps do not need any oil for lubrication. The lobe vacuum pumps are cooled by the air transported through the pump. If the number of revolutions is low, the cooling of the pump may be insufficient and the number of revolutions has to be increased. Therefore, conventional lobe vacuum pumps have to operate many times with a higher capacity than required in order to maintain the vacuum level in the vacuum system. Consequently, conventional lobe vacuum pumps in milking arrangements have an unnecessary high energy consumption. In order to solve this problem, a forced cooling of the pump housing has been proposed. However, such a cooling is unfavourable since it does not result in an appreciable cooling of the rotors and may result in a smaller play between the rotors and the inner surface of the housing, which increases the risk of the pump breaking down due to the rotors and/or the rotors and the inner surfaces jamming.

Another problem with conventional lobe vacuum pumps used in milking arrangements, it is that deposits, which originate from the milk but also from e.g. detergents, dust and hay, are formed on the surfaces of the rotors and the inner surfaces of the housing. Consequently, it may be necessary to dismount the vacuum pump and perform a cleaning of its inner surfaces at regular intervals.

JP 8109888 shows a vacuum pump comprising a body case having an inner space with a suction port, which is connected to

An arrangement and a method for the treatment of a vacuum pump

THE BACKGROUND OF THE INVENTION AND PRIOR ART

The present invention relates to an arrangement and a method for the treatment of a vacuum pump of the kind comprising a housing having a surface defining an inner space, at least one inlet opening in the housing arranged to lead a gaseous medium from a vacuum system to said inner space, at least one outlet opening in the housing arranged to lead the gaseous medium out from said inner space, and at least one rotor mounted in said space and arranged to transport the gaseous medium from the inlet opening to the outlet opening, wherein the arrangement comprises a liquid supplying device which is arranged to enable a supply of liquid to said inner space and the invention also relates to a vacuum pump system.

Vacuum pumps are used, for example, to maintain a substantially constant vacuum pressure in a vacuum system of a milking arrangement. During the relatively short period, which comprises the start of the milking arrangement and the attachment of milking members to the animal to be milked, a relatively high capacity is required by the vacuum pump in order to maintain the vacuum level in the vacuum system. During the remaining periods, a relatively low capacity of the vacuum system is required. Therefore, the vacuum pump has to operate with a low capacity during the main part of its operating time i.e. with a low number of revolutions. Consequently, vacuum pumps

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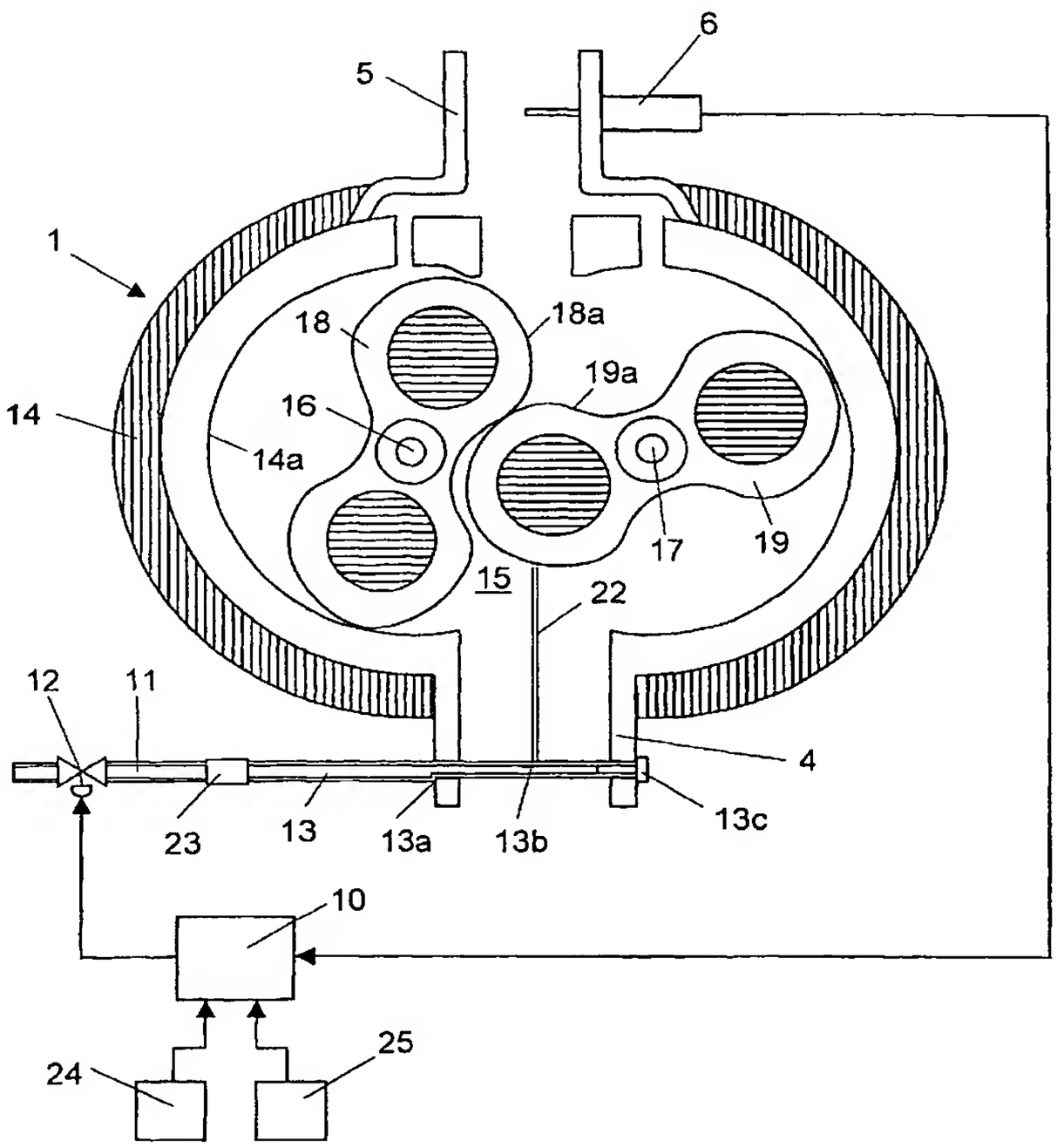
(54) Title: AN ARRANGEMENT AND A METHOD FOR THE TREATMENT OF A VACUUM PUMP



(57) Abstract: The invention relates to an arrangement and a method for the treatment of a vacuum pump, which preferably is a lobe vacuum pump (1). The arrangement comprises a liquid supplying device which is arranged to enable a supply of liquid to said inner space (15) and a liquid supply control member (12) which is arranged to enable the control of the supply of liquid of said liquid supply device to said inner space (15) such that the liquid is supplied to said inner space (15) only at certain occasions.

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